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Early stage Life Cycle Assessment of different Green Biorefinery configurations: assessing the utilization of the press-pulp

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The Green biorefinery (GBR) is a new biorefinery technology to convert fresh biomass into fuel, feed and chemicals. The GBR fractionates the biomass into two fractions: a liquid fraction, i.e. the press-juice and a solid fraction, i.e. the press-pulp. A protein-rich feed is produced from the press-juice, while different downstream process has been proposed for the upgrade of the press-pulp (Kromus et al., 2006).

This study evaluates the environmental performance of different upgrade strategies for the press-pulps by using Life Cycle Assessment (LCA) at an early stage of the design process. The studied press-pulp utilization scenarios are: ensiling and utilization as energy-feed for ruminants; drying and utilization as a thermal insulation panel; utilization as a fermentation feedstock for lysine production. The system boundaries go from cradle to the biorefinery gate. Furthermore, they are also expanded to include the credits connected to the substitution of conventional products by the GBR products. The functional unit of the study is: "production and conversion in the GBR of 1ton$_{DM}$ of biomass".

As seen in Figure 1, the downstream utilization of the press-pulp and the type of replaced conventional product has large effects on the environmental profile of the GBR. If the press-pulp is used to replace conventional energy-intensive materials (e.g. thermal insulation panels), there are large savings on energy related impact categories (ICs) such as Global Warming and Non-Renewable Energy use. If the replaced product is agricultural-based (e.g. silage or lysine), we can observe large savings on agricultural related ICs i.e. Agricultural Land Occupation and Eutrophication. Furthermore, while comparing the last two scenarios, the Lysine scenario has the best overall performance, suggesting that the production of high-value products leads to higher environmental savings.

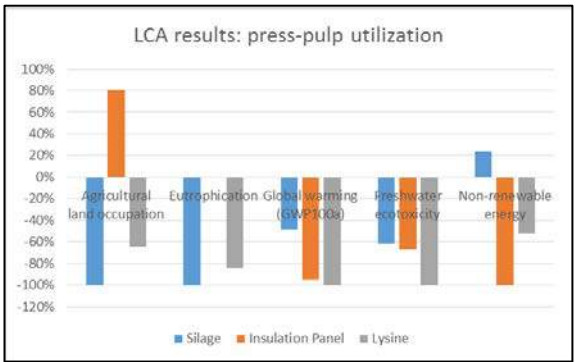

Figure 1: LCA results for the different utilization of the press-pulp. Results calculated for the conversion of the conversion of 1ton$_{DM}$ of biomass.

Biorefining of green biomass can be technically possible and can bring environmental benefits compared to the conventional production. However, those benefits are largely dependent on the downstream utilization of the press-pulp, and consequently from the replaced conventional products.

References:

Kromus, S., Kamm, B., Kamm, M., Fowler, P., 2006. Green Biorefineries The Green Biorefinery Concept – Fundamentals and Potential.